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*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH

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THE FIRST VOLUME OF THE PUBLICATIONS OF THE "CHALLENGER"

FOUR years have elapsed since the *Challenger* returned from her famous cruise, and the scientific world has been looking, of late perhaps somewhat impatiently, for the first instalment of the long series of volumes which is to embody the results of the investigations of the best-equipped voyagers who ever left the shores of England for the purpose of enlarging the bounds of natural knowledge.

But this is one of the many cases in which impatience is more natural than justifiable. In the "General Introduction" with which Sir Wyville Thomson prefaces the "Reports" which are to appear in the first volume of the great work for which he is responsible, he mentions that the zoological specimens collected and preserved in alcohol during the voyage filled 2270 large glass jars, 1749 smaller bottles, 1860 glass tubes, and 176 tin cases; while 22 casks and 180 tin cases held objects preserved in other ways.

In dealing with this vast mass of material, Sir Wyville Thomson justly considered it to be his duty to obtain, as far as it was practicable so to do, the co-operation of the best specialists in every department, irrespective of nationality; and it is gratifying to find that, in reply to his invitations, many foreign men of science of great distinction have willingly associated themselves with a strong corps of English workers. This matter being arranged, the specimens had to be distributed to their destinations; and the several workers, rarely men of much leisure, found themselves embarked in months or years of critical and laborious investigation. Along with this went the slow process of writing out the results, and the still slower of executing the illustrations with due care, all of which had to be finished before the printer could begin his operations.

To those who are familiar with the amount of expenditure of trouble and time which all these processes mean, it will seem no small matter that seven treatises, illustrated by a large number of admirably executed plates, are now

ready for distribution, and that three more volumes of no less magnitude are to be issued before the end of the year; so that the fifteen or sixteen volumes of which the whole work is to consist may reasonably be expected to be in the hands of the public by 1884.

The "Zoological Reports," as these separate treatises upon each group of specimens are termed, are printed as they are completed, and are to be issued, without reference to the order which they will eventually occupy, as soon as sufficient matter to form a volume is ready. Each memoir will be separately paged, and will have its own legend for reference. This arrangement has been adopted in order that working naturalists may have access to the "Reports" as early as practicable, and that the multiplication of synonyms by the simultaneous publication of species by different observers may be avoided. With this object in view, it would perhaps have been even better to have issued every "Report" as it was ready; but it may be that there are practical difficulties in the way of the adoption of this course.

The present writer, though a fairly swift reader, does not profess to have perused the seven elaborate memoirs now presented on behalf of the *Challenger*; nor if he had does he lay claim to that zoological omniscience which would justify him in criticising them in detail. But as Mr. Brady deals with the Ostracoda, Mr. Davidson with the Brachiopoda, Dr. Günther with the Shore Fishes, Prof. Kölliker with the Pennatulidæ, Mr. Moseley with those groups of Corals which he has made his special study, Mr. Parker with the Development of the Chelonian Skull, and Prof. Turner with the Cetacea, it is questionable if any extant finite knowledge is likely to enable its possessor to say anything more or better than they have said on these respective topics. And, as has been already remarked, there can be no sort of doubt as to the artistic excellence of the 122 quarto plates which illustrate and adorn the text.

Sir Wyville Thomson's "General Introduction," however, is extremely readable both in size and in substance, and may be commended to that patient omnivore, the General Reader, who will find in its earlier pages a readily intelligible account of the fittings and appliances of the *Challenger*, and of the means by which the greatest depths of the sea have been made to yield some, at any

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rate, of the secrets of the busy life which, contrary to all the beliefs of the naturalists of a past generation, blindly toils and moils in the darkness and cold of the marine abysses.

The latter half of the "Introduction" will be no less interesting to the biologist, since it embodies the general conclusions at which the scientific director of the Expedition has arrived, in a dissertation on the nature and distribution of the fauna of the deep sea.

Sir W. Thomson considers that the most "prominent and remarkable biological result" of the four years' work of the *Challenger* is the final establishment of the fact "that the distribution of living beings has no depth-limit, but that animals of all the marine invertebrate classes, and probably fishes also, exist over the whole of the floor of the ocean." As to the exact nature of this deep-sea fauna at the greatest depths, he speaks with some hesitation; but, at about 2000 fathoms, the list given on pages 36 and 37 proves that there is a large and a varied assemblage of forms of life. Upwards, this characteristic deep-sea fauna extends to about 600 fathoms, and is richest between this depth and 1000 or 1200 fathoms. Around all coasts, in temperate regions, the local shore forms, which occupy successive zones of depth as, on land, they characterise zones of height, gradually die out towards the 200-fathom line. Nor is there any close relation between the abyssal and the shore fauna of any given latitude or longitude—on the contrary, the abyssal fauna is singularly uniform and appears "to have been derived from a genetic source different from that of the shore fauna." In fact, Sir Wyville Thomson appositely compares the abyssal ocean—that is the sea everywhere below 200 fathoms or thereabouts—to a world-wide lake of comparatively still water, which, in its deeper parts, is very cold, its temperature neither rising nor falling appreciably beyond the average of 35° F.

Thus there is a certain parallel between land and sea distribution, inasmuch as all Alpine floræ present marked analogies with circumpolar floræ. The cold land is discontinuous, whence it presents, as it were, islands of analogous population all over the world; while the cold water being continuous, the continuity in its population is correspondingly unbroken. But the uniformity and invariability of conditions is far more complete in the abyssal lake than on the mountain-tops; and the homogeneity of the population harmonises with that of the medium in which it lives.

Sir Wyville Thomson draws attention to the fact that this widespread abyssal fauna

"... has a relation to the deep-water fauna of the Oolite, the Chalk, and the Tertiary formations, so close that it is difficult to suppose it in the main other than the same fauna which has been subjected to a slow and continuous change under slightly varying circumstances according to some law, of the nature of which we have not as yet the remotest knowledge" (p. 49).

"There is every reason to believe that the existing physical conditions of this area date from a very remote period, and that the present fauna of the deep sea may be regarded as directly descended from fauna which have necessarily occupied the same deep sea. . . . That the present abyssal fauna is the result of progressive change there can be no room for doubt; but it would seem that in this case, the progress has been extremely slow, and that it has been brought about almost in the absence of

those causes—such as minor and local oscillations of the crust of the earth producing barriers and affecting climate—on which we are most inclined to depend for the modification of fauna. The discovery of the abyssal fauna, accordingly, seems to have given us an opportunity of studying a fauna of extreme antiquity, which has arrived at its present condition by a slow process of evolution from which all causes of rapid change have been eliminated" (p. 50).

That the deep-sea fauna presents us with many forms which are the dried and but little modified descendants of Tertiary and Mesozoic species is a proposition which few who attend to the evidence will be disposed to deny. But I may venture to express some doubt, whether it may not be well to keep a conclusion of such gravity and so well founded, apart from views respecting the absence of "minor local oscillations of the crust of the earth" in the area of the present great ocean basins, which Sir Wyville Thomson expresses more fully elsewhere.

"There seems to be sufficient evidence that all changes of level since the close of the Palæozoic period are in direct relation to the present coast lines.

"There does not seem to be a shadow of reason for supposing that the gently undulating plains, extending for over a hundred million of square miles, at a depth of 2500 fathoms beneath the surface of the sea, and presenting, like the land, their local areas of secular elevation and depression, and their centres of more active volcanic disturbance were ever raised, at all events in mass, above the level of the sea; such an arrangement, indeed, is inconceivable" (p. 46).

I must plead ignorance of the "sufficient evidence" to which Sir Wyville Thomson refers; in fact, I should have thought that the sufficient evidence lay in the other direction. Surely there is evidence enough and to spare that the Cretaceous sea, inhabited by various forms, some of whose descendants Sir W. Thomson, as I believe justly, recognises in the present deep-sea fauna, once extended from Britain over the greater part of Central and Southern Europe, North Africa, and Western Asia to the Himalayas. In what possible sense can the change of level which has made dry land and sometimes mountain masses of nine-tenths of this vast area be said to be "in direct relation to the present existing coast lines"?

That the abyssal plains were ever all elevated, at once, is certainly so improbable that it may justly be termed inconceivable; but there is nothing, so far as I am aware, in the biological or geological evidence at present accessible, to render untenable the hypothesis that an area of the mid-Atlantic or of the Pacific sea-bed as big as Europe should have been upheaved as high as Mont Blanc and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it.

In concluding the "Introduction" Sir Wyville Thomson expresses "a strong personal impression" on two points. The one is that the study of the abyssal fauna lends a powerful support to the doctrine of evolution. The other is, that "the character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection." But the grounds assigned for the latter opinion are hardly so cogent as might be desirable.

"Species are just as distinctly marked in the abyssal

fauna as elsewhere, each species varying within its definite range as each species appears to have varied at all times past and present" (p. 50).

Exactly so; the abyssal species are like species elsewhere. The difficulties in the way of the application of the evolution of species by variation and selection therefore in this case cannot be greater than elsewhere. In fact, from the sentences which end the "Introduction" it seems doubtful whether they are not less than in many other cases.

"Transition forms linking species so closely as to cause a doubt as to their limit are rarely met with. There is usually no difficulty in telling what a thing is" (p. 50).

Hence it appears that the study of the abyssal fauna has satisfied Sir Wyville Thomson that transitional forms are sometimes met with; and that, sometimes, he has found a difficulty in "telling what a thing is." And this admission is all that the most ardent disciple of Mr. Darwin could desire.

However, the value of the great work which is now being brought before the public does not lie in the speculations which may be based upon it, but in the mass and the solidity of the permanent additions which it makes to our knowledge of natural fact. Sir Wyville Thomson and his colleagues must be congratulated on having made an excellent beginning; the looker-on may properly content himself with wishing them a speedy and a good ending.

T. H. HUXLEY

THE LAVA-FIELDS OF NORTH-WESTERN EUROPE

FROM the earliest times of human tradition the basin of the Mediterranean has been the region from which our ideas of volcanoes and volcanic action have been derived. When the old classical mythology passed away and men began to form a more intelligent conception of a nether region of fire, it was from the burning mountains of that basin that the facts were derived which infant philosophy sought to explain. Pindar sang of the crimson floods of fire that rolled down from the summit of Etna to the sea as the buried Typhoeus struggled under his mountain load. Strabo, with matter-of-fact precision and praiseworthy accuracy, described the eruptions of Sicily and the Aeolian Islands, and pointed out that Vesuvius, though it had never been known as an active volcano, yet bore unequivocal marks of having once been corroded by fires that had eventually died out from want of fuel. In later centuries, as the circle of human knowledge and experience has widened, it has still been by the Mediterranean type that the volcanic phenomena of other countries have been judged. When a geologist thinks or writes of volcanoes and volcanic action, it is the structure and products of such mountains as Etna and Vesuvius that are present to his mind. Nowhere over the whole surface of the globe have eruptions been witnessed different in kind though varying in degree from those of the Mediterranean vents. And hence even among those who have specially devoted themselves to the study of volcanoes there has been a tacit assumption that from the earliest times and in all countries of the world where volcanic outbreaks have occurred, it has been from local vents like those of Etna, the Aeolian Islands, the Phlegrean Fields, or the Greek Archipelago.

If one were to assert that this assumption is probably erroneous, that the type of volcanic "cones and craters" has not been in every geological age and all over the earth's surface the prevalent one, that, on the contrary, it is the less portentous, though possibly always the most frequent type of volcanic action, and belongs perhaps to a feebler or waning degree of volcanic excitement—these statements would be received by most European geologists with incredulity, if not with some more pronounced form of dissent. Yet I am convinced that they are well founded, and that a striking illustration of their truth is supplied by the greatest of all the episodes in the volcanic history of Europe—that of the basalt-plateaux of the north-west.

It is now some twelve years since Richthofen pointed out that on the Pacific slope of North America there is evidence of the emission of vast floods of lava without the formation of cones and craters. Geologists interested in these matters may remember with what destructive energy Scrope reviewed his "Natural System of Volcanic Rocks"; how he likened it to the old crude ideas that had been in vogue in his younger days, and which a study of the classical district of Auvergne had done so much to dispel; and how he ridiculed what he regarded as "fanciful ideas" and "untenable distinctions," which it was "a miserable thing" to find still taught in mining-schools abroad. My own reverence for the teaching of so eminent a master and so warm-hearted a friend led me to acquiesce without question in the dictum of the author of "Considerations on Volcanoes." Having rambled over Auvergne with his admirable sections and descriptions in my hand, I knew his contention as to the removal of cones and craters by denudation and the survival of more or less fragmentary plateaux once connected with true cones to be undoubtedly correct with respect at least to that region. Nevertheless there were features of former volcanic action on which the phenomena of modern volcanoes seemed to me to throw very little light. In particular the vast number of fissures which in Britain had been filled with basalt and now formed the well-known and abundant "dykes" appeared hardly to connect themselves with any known phase of volcanism. The area over which these dykes can be traced is probably not less than 100,000 square miles, for they occur from Yorkshire to Orkney, and from Donegal to the mouth of the Tay. As they pierce formations of every age, including the Chalk, as they traverse even the largest faults and cross from one group of rocks into another without interruption or deflection, as they become more numerous towards the great basaltic plateaux of Antrim and the Inner Hebrides, and as they penetrate the older portions of these plateaux, I inferred that the dykes probably belonged to the great volcanic period which witnessed the outburst of these western basalts. Further research has fully confirmed this inference. There can be no doubt that the outpouring of these great floods of lava of which the hills of Antrim, Mull, Morven, Skye, Faroe, and part of Iceland are merely surviving fragments and the extravasation of these thousands of dykes are connected manifestations of volcanic energy during the Miocene period.

But this association of thin nearly level sheets of basalt piled over each other to a depth of sometimes 3,000 feet, with lava-filled fissures sometimes 200 miles distant from